CLAIMS

1. A plasma chamber comprising:

a vacuum chamber enclosure enclosing a chamber interior;

a gas inlet aperture for admitting a gas into the chamber interior;

a plasma excitation power source for coupling energy to the gas so as to excite at least a portion of the gas to produce a plasma within the chamber interior;

an exhaust pump;

an exhaust channel extending between the chamber interior and the exhaust pump so as to provide a path for gas flow from the chamber interior to the exhaust pump;

a deflector positioned within the exhaust channel so as to create turbulence in said gas flow through the exhaust channel; and

a magnet system having north and south magnetic poles positioned adjacent the deflector.

2. A plasma chamber according to claim 1, wherein the magnet system produces a magnetic field strong enough to block said plasma from extending from the chamber interior to the exhaust pump.

3. A plasma chamber according to claim 1, further comprising:

a chuck for holding a substrate at a substrate position within the chamber interior;

wherein the magnet system is positioned far enough from the substrate position so that the magnet system does not produce a magnetic field greater than 5 gauss at the substrate position.

4. A plasma chamber according to claim 1, wherein:

the magnet system has an annular shape and is positioned coaxially with the exhaust channel.

5. A plasma chamber according to claim 1, wherein:

the north and south magnetic poles are spaced apart along said gas flow path.

6. A plasma chamber according to claim 1, wherein:

the north and south magnetic poles are positioned on opposite sides of said gas flow path so as

to produce a magnetic field transverse to said gas flow path.

7. A plasma chamber comprising:

a vacuum chamber enclosure enclosing a chamber interior;

a gas inlet aperture for admitting a gas into the chamber interior;

a plasma excitation power source for coupling energy to the gas so as to excite at least a portion of the gas to produce a plasma within the chamber interior;

an exhaust pump;

an exhaust channel extending between the chamber interior and the exhaust pump so as to provide a path for gas flow from the chamber interior to the exhaust pump;

a deflector positioned within the exhaust channel so as to transversely deflect a substantial portion of said gas flow through the exhaust channel; and

a magnet system having north and south magnetic poles positioned adjacent the deflector.

8. A plasma chamber according to claim 7, wherein:

the exhaust channel comprises

an inlet aperture in fluid communication with the chamber interior,

an outlet aperture in fluid communication with the pump, and

at least a first wall that extends between the inlet aperture and the outlet aperture;

the deflector comprises a protrusion extending from the first wall of the exhaust channel into the exhaust channel so as to reduce the transverse width of the exhaust channel adjacent the protrusion; and

the north and south poles of the magnet system are positioned within the protrusion.

9. A plasma chamber according to claim 8, wherein:

the pump produces a flow of gas from the chamber interior, through a gas flow path within the exhaust channel, and to the pump; and

the north and south magnetic poles are spaced apart along said gas flow path.

10. A plasma chamber according to claim 8, wherein the magnet system produces a magnetic field strong enough to block said plasma from extending from the chamber interior through the exhaust channel beyond the protrusion.

11. A plasma chamber according to claim 8, further comprising:

a chuck for holding a substrate at a substrate position within the chamber interior;

wherein the magnet system is positioned far enough from the substrate position so that the magnet system does not produce a magnetic field greater than 5 gauss at the substrate position.

12. A plasma chamber according to claim 8, wherein:

the protrusion has an annular shape and is positioned coaxially with the exhaust channel; and

the magnet system has an annular shape and is positioned coaxially with the exhaust channel.

13. A plasma chamber, comprising:

a vacuum chamber enclosure enclosing a chamber interior;

a gas inlet aperture for admitting a gas into the chamber interior;

a plasma excitation power source for coupling energy to the gas so as to excite at least a portion of the gas to produce a plasma within the chamber interior;

an exhaust pump;

an exhaust channel including

an inlet aperture in fluid communication with the chamber interior,

an outlet aperture in fluid communication with the pump, and

at least a first wall that extends between the inlet aperture and the outlet aperture; and

a magnet system having north and south magnetic poles positioned adjacent the first wall;

wherein the plasma chamber does not include any other magnet adjacent said magnet system.

14. A plasma chamber according to claim 13, wherein:

the pump produces a flow of gas from the chamber interior, through a gas flow path within the exhaust channel, and to the pump; and

the north and south magnetic poles are spaced apart along said gas flow path.

15. A plasma chamber according to claim 13, wherein:

the north and south magnetic poles are adjacent a first area of the first wall; and

the magnet system produces a magnetic field strong enough to block said plasma from extending from the chamber interior through the exhaust channel beyond said first area.

16. A plasma chamber according to claim 13, further comprising:

a chuck for holding a substrate at a substrate position within the chamber interior;

wherein the magnet system is positioned far enough from the substrate position so that the magnet system does not produce a magnetic field greater than 5 gauss at the substrate position.

17. A magnet system comprising:

a cylindrical, magnetically permeable pole piece having first and second axially opposite ends;

an annular first magnet having north and south poles at radially inner and outer ends, respectively, wherein the first magnet is positioned coaxially with the pole piece so as to abut the first end of the pole piece; and

an annular second magnet having south and north poles at radially inner and outer ends, respectively, wherein the second magnet is positioned coaxially with the pole piece so as to abut the second end of the pole piece.

18. A magnet system according to claim 17, wherein:

the outer end of the first magnet abuts the pole piece; and

the outer end of the second magnet abuts the pole piece.

19. A magnet system according to claim 17, wherein:

the inner end of the first magnet abuts the pole piece; and

the inner end of the second magnet abuts the pole piece.

20. A magnet system according to claim 17, wherein the exhaust channel has an annular shape and the first wall provides a radially inner boundary of the exhaust channel.

21. A magnet system according to claim 17, wherein the exhaust channel has an annular shape and the first wall encircles the exhaust channel.

22. A magnet system according to claim 17, wherein the exhaust channel has a generally cylindrical shape and the first wall encircles the exhaust channel.

23. A magnet system comprising:

a cylindrical magnet having north and south poles at axially opposite ends of the magnet;

a first magnetically permeable pole piece that is annular in shape and is positioned coaxially with the magnet so as to abut the north pole of the magnet; and

a second magnetically permeable pole piece that is annular in shape and is positioned coaxially with the magnet so as to abut the south pole of the magnet.

24. A magnet system according to claim 23, wherein:

the first pole piece has a radially outer end that abuts the north pole of the magnet; and

the second pole piece has a radially outer end that abuts the south pole of the magnet.

25. A magnet system according to claim 23, wherein:

the first pole piece has a radially inner end that abuts the north pole of the magnet; and

the second pole piece has a radially inner end that abuts the south pole of the magnet.

26. A method of preventing the plasma within a plasma chamber from extending through the exhaust channel of the chamber to the exhaust pump, comprising the steps of:

providing a vacuum chamber enclosure that encloses a chamber interior;

admitting a gas into the chamber interior;

coupling energy to the gas so as to excite at least a portion of the gas to produce a plasma within the chamber interior;

providing an exhaust channel extending between the chamber interior and an exhaust pump so as to provide a path for gas flow from the chamber interior to the exhaust pump;

positioning a deflector within the exhaust channel so as to create turbulence in said gas flow

through the exhaust channel; and

creating a magnet field within the exhaust channel having a substantial component that is transverse to said gas flow path.

27. A method according to claim 26, wherein the creating step comprises:

creating said magnetic field with sufficient strength to block said plasma from extending from the chamber interior to the exhaust pump.

28. A method according to claim 26, further comprising the step of:

holding a substrate at a substrate position within the chamber interior;

wherein the creating step comprises creating said magnetic field with a strength that diminishes sufficiently from the exhaust channel to the substrate position so that said magnetic field is no greater than 5 gauss at the substrate position.

29. A method according to claim 26, wherein the creating step comprises:

positioning an annular magnet system coaxially with the exhaust channel.

30. A method according to claim 26, wherein the creating step comprises:

positioning a magnet system adjacent the exhaust channel so that north and south magnetic poles of the magnet system are spaced apart along said gas flow path.

31. A method according to claim 26, wherein the creating step comprises:

positioning a magnet system adjacent the exhaust channel so that north and south magnetic poles of the magnet system are positioned on opposite sides of said gas flow path so as to produce a magnetic field transverse to said gas flow path.